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Assessing the potential impacts of non-native small mammals in the South African pet trade

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Abstract
The pet trade is one of the most important pathways by which small mammals are introduced to non-native areas. To prevent the introduction and invasion of non-native pets, an impact assessment protocol is useful in understanding which pets might have potential negative impacts should they escape or be released from captivity. In this study, we used the Generic Impact Scoring System (GISS) to assess the potential effects associated with 24 non-native small mammal species sold in the South African pet trade. European rabbits *Oryctolagus cuniculus*, house mice *Mus musculus*, Norwegian rats *Rattus norvegicus* and eastern grey squirrels *Sciurus carolinensis* had the highest potential impacts for both socio-economic and environmental categories. We found no statistically significant difference between the overall environmental and socio-economic impact scores. Impacts on agricultural and animal production (livestock) were the main mechanisms in the socio-economic category, while the impacts on animals (predation), competition and hybridisation prevailed for environmental impacts. The non-native mammal pet species with high impacts should be strictly regulated to prevent the potential impacts and establishment of feral populations in South Africa.

Keywords
GISS, introduction pathways, invasions, impact assessment, policy implementation

Introduction

Different invasion pathways have been associated with the introduction and spread of non-native species (McNeely 2006; Hulme 2009). These pathways include accidental introductions (e.g. hitch-hikers or contaminants of transported goods) and intentional introductions through horticulture, biocontrol and pet trade (Padilla and Williams 2004; Hulme 2009; Keller et al. 2011). The latter has gained considerable attention over the past decades as the global trade in live animals increases (Keller and Lodge 2007; Faulkner et al. 2016; Ng et al. 2016; Lockwood et al. 2019). Some of the non-native pet species may establish self-sustaining populations through accidental escapes and intentional releases (Gaertner et al. 2015; da Rosa et al. 2017); for example, European rabbit *Oryctolagus cuniculus*, eastern grey squirrel *Sciurus carolinensis*, common marmoset *Callithrix jacchus* and the black tufted-ear marmoset *Callithrix penicillata* (Huynh et al. 2010; da Rosa et al. 2017; Measey et al. 2020).

Non-native pets have been associated with negative impacts on biodiversity, human health, the economy, and agriculture (Marbuah et al. 2014; Su et al. 2015; Shivambu et al. 2020). In Brazil, the common marmoset *C. jacchus* has been reported to negatively affect the population of vulnerable buffy-tufted marmosets *C. aurita* through hybridisation (Nogueira et al. 2011; Malukiewicz et al. 2014). An increase in the trade of non-native small mammal species is also associated with outbreaks of zoonotic diseases, e.g. Salmonellosis in 28 patients in the USA has been linked to pet rodents such as mice, rats and hamsters (Hargreaves 2007). The common marmoset has been implicated into transmitting rabies to humans in Brazil (Kotait et al. 2019). Economic impacts have also been reported for some non-native small mammals, e.g. the European rabbit *O. cuniculus* has been indicated to compete with livestock for pasture in Australia (Fleming et al. 2002). In addition, species such as the eastern grey squirrel, the Norwegian rat *Rattus norvegicus* and the house mouse *Mus musculus* have been reported to cause impacts on infrastructures and crops of economic importance (Signorile and Evans 2007; Almeida et al. 2013; Panti-May et al. 2017).

The negative impacts associated with any introduced species can be partly prevented by prohibiting the trade of those non-native species with known harmful impacts and invasive potential (Vaes-Petignat and Nentwig 2014; van der Veer and Nentwig 2015; da Rosa et al. 2018). In cases where non-native pet species have already been introduced but not yet established, possible impacts can be avoided by preventing their release or escape from captivity (da Rosa et al. 2018). In South Africa, the pet trade has been cited as an invasion pathway for different non-native animals through releases and accidental escapees, including species such as the mallard duck *Anas platyrhynchos* (Gaertner et al. 2015), the rose-ringed parakeet *Psittacula krameri* (Hart and Downs 2014), and the Australian red claw crayfish *Cherax quadricarinatus* (Nunes et al. 2017). The South African National Environmental Management: Biodiversity Act (No. 10 of 2004) (NEMBA) requires that impact and risk assessments are undertaken by either the issuing authority or the importer before issuing permits for non-native species being imported, sold, kept in captivity or released into the wild (van Wilgen et al. 2008).

Impact and risk assessment protocols are considered to be cost-effective and reliable methods that can be used to identify potential invasion impacts, enable ranking of them and support decision-making (Jeschke et al. 2014; da Rosa et al. 2018; Shivambu et al. 2020). Both impact and risk assessment protocols have been successfully used for fishes (van der Veer and Nentwig 2015), plants (Novoa et al. 2016) and for species in the pet trade (Bomford et al. 2005; Patoka et al. 2014; da Rosa et al. 2018; Weiperth et al. 2018) to investigate the potential invasion risks and impacts.

The present study focused on non-native small mammals sold as pets in South Africa. These non-native small mammal species include rodents, lagomorphs, primates, Eulipotyphla, carnivores, Afrosoricida, and Diprotodontia (Suppl. material 1, Table S1). These small mammal pets are traded on different platforms, including online, among breeders and in pet shops (Maligana et al. 2020). There is a relative paucity of information on the potential impacts associated with non-native small mammals sold as pets in South Africa. Non-native small mammal pets such as the sugar glider *Petaurus breviceps* (Heinsohn et al. 2015), the domesticated ferret *Mustela putorius furo* (Davison et al. 1999), the European rabbit (Fleming et al. 2002), the common and the black tufted-ear marmoset (Malukiewicz et al. 2014; Kotait et al. 2019) have been reported to cause impacts in their invaded areas. The aim of the present study was, therefore, to identify which non-native small mammal species sold as pets in South Africa have potentially high environmental and/or socio-economic impacts. We also investigated which impact mechanisms are associated with them. Given that previous studies found that non-native birds and mammals are associated with economic impacts (Kumschick and Nentwig 2010; Nentwig et al. 2010), we predicted that most of the non-native small mammal species traded as pets in South Africa would be more associated with socio-economic impacts rather than environmental impacts. In addition, some of the small mammal species, especially rodents, are associated with human habitation (Garba et al. 2014; Panti-May et al. 2017) and therefore, we expected them to cause more economic than environmental impacts.

Methods

Study species

In this study, pet shops were visited in South Africa to document the list of non-native small mammals sold. The list was complemented with data collated from the online trade. All pet shops and online websites were surveyed four times, once per season (spring, summer, autumn, and winter) between September 2018 and September 2019. During each visit, the numbers of each mammal species were recorded to determine the prevalence. We averaged the numbers of each species for both online and pet shop trade to indicate the most prevalent species. We carried out the impact assessments for 24 non-native small mammals sold in pet shops and online (Maligana et al. 2020; Suppl. material 1, Table S1).

Impact assessments

We conducted impact assessments using the Generic Impact Scoring System (GISS) (Nentwig et al. 2010). This tool depends on published evidence associated with environmental and socio-economic impacts of the studied species and allows comparisons and prioritisation. The environmental impacts (Kumschick and Nentwig 2010) were grouped into six impact categories, which included impacts on plants or vegetation (herbivory), impacts on animals (predation), competition, disease transmission, hybridisation, and impacts on ecosystems. The socio-economic impacts were also grouped into six categories, which included impacts on agricultural production, animal production (livestock), forestry production, human infrastructure, human health, and human social impacts (Kumschick and Nentwig 2010; Nentwig et al. 2010). The impact mechanism for each category under environmental and socio-economic impacts ranged from 0 to 5 (0: no impact or literature associated with scored species, 1–2: minor impacts, 3: medium impacts, and 4–5: major impacts) (Nentwig et al. 2010). The potential maximum scores for both environmental and socio-economic impacts is 60. Information on the impacts of the assessed species was retrieved by searching on Google Scholar and Web of Science (https://clarivate.com/) using the scientific and common names of the species in combination with each impact mechanism, for example, "*Oryctolagus cuniculus* impacts on plants or vegetation", "*Callithrix jacchus* impacts on animals", "house mouse impacts on agricultural production", and "*Cebus capucinus* impacts on human social life". In the present study, we only assessed the impacts associated with feral populations of non-native small mammals. We did not assess the reported impacts associated with non-native small mammals in captivity. The assessments of the impacts were based on the publication records entirely from areas outside South Africa.

Statistical analyses

We tested the similarity between the sum of the GISS environmental and socio-economic impact scores using the paired Wilcoxon's signed-rank tests. We tested for significant differences between the mechanisms for environmental and socio-economic impacts using a Kruskal-Wallis test, and the Mann-Whitney pairwise tests were used to test for differences within the species and within the impact mechanisms. All statistical analyses were performed in R statistical software (version 3.4.4, R Core Team, 2018).

Results

Impact assessments

We found a total of 122 pet shops and seven online websites selling 24 non-native small mammals in South Africa. The European rabbit, the Norwegian rat, the house

mouse and the Guinea pig were the most prevalent species in both pet shops and online (Suppl. material 2, Table S2). The first three species and the eastern grey squirrel are established species in South Africa (Table 1). A total of 106 publications were found and used to rank the impacts of these species. Of the 24 non-native mammal species traded, we could only find published impacts for 10 species and therefore assessed those. The literature ranged between 1 to 23 publications for a single species, and for some of the species, the literature was identical (Suppl. material 2, Table S2). The total GISS scores ranged from 3 to 40, with environmental impact ranging from 0 to 18 and socio-economic impacts ranging from 0 to 22 (Table 1). The total score for environmental impact was 115 and for socio-economic impact was 81 (Table 1). When comparing the overall scores between the two impacts, there was no significant difference between overall environmental and socio-economic impact scores (Wilcoxon signed-rank test, $V = 23$, $P = 0.1022$). European rabbit, Norwegian rat and house mouse had the highest overall GISS scores (between 32 and 40) representing between 53% and 67% of the maximum impact assessment score (i.e. 60) (Table 1).

All the non-native mammal species assessed in the present study had environmental impacts, except for the Mongolian gerbil *Meriones unguiculatus* (Table 1, Fig. 1a). There was no significant difference between the potential environmental impacts of the non-native small mammal species assessed (Kruskal-Wallis test; $X^2 = 3.01$, df = 9, $P = 0.90$). The species with the highest environmental impact were the European rabbit, followed by the house mouse and the Norwegian rat (Table 1). These species represented between 50% and 60% of the maximum environmental impact score (i.e. 30).

Seven out of 10 of the non-native mammal species traded as pets had socio-economic impacts in the present study (Table 1, Fig. 1b). There was a significant difference between the socio-economic impact scores for the 10 non-native small mammals traded as pets (Kruskal-Wallis test, $X^2 = 22.27$, df = 9, $P = 0.003$, Fig. 1b). The European rabbit, the house mouse and the Norwegian rat had significantly higher socio-economic impacts when compared with the other seven species (Mann-Whitney pairwise test, Bonferroni corrected p values, $P < 0.001$, Table 1, Fig. 1b). They represented more than 50% of the maximum socio-economic impact score (i.e. 30).

Environmental impacts mechanisms

Between the environmental impact mechanisms, significant differences were found (Kruskal-Wallis test, $X^2 = 15.63$, df = 5, $P = 0.002$, Table 1). The only significant difference found was between the impact on animals (predation), disease transmission and the impact on the ecosystem (Mann-Whitney pairwise test, Bonferroni corrected p values, $P < 0.001$). The impact on animals (predation), competition, and hybridisation were the most common mechanisms followed by the impact on plants and vegetation (herbivory), impact on ecosystems, and disease transmission

Table 1. The GISS scores of 10 non-native small mammal species sold in the South African pet trade. The sum of each impact category is given, and the total impact indicates the overall sum of environmental and socio-economic impacts for each species. Detailed scores for each species and literature used are available in the Suppl. material 2, Table S2. An asterisk indicates species established in South Africa (see Picker and Griffiths 2017, and Measey et al. 2020).

Species	Common names	Environmental impact							Socio-economic impact							Overall GISS impact scores	Number of literature used
		Plants or vegetation (Herbivory)	Animals (Predation)	Competition	Diseases transmission	Hybridisation	Ecosystems	Overall environmental scores	Agricultural production	Animal production (Livestock)	Forestry production	Human Infrastructure	Human health	Human social life	Overall socio-economic scores		
Callithrix jacchus	Common marmoset	0	3	5	0	5	0	**13**	0	0	0	0	3	0	**3**	**16**	10
Callithrix penicillata	Black tufted-ear marmoset	0	2	5	0	5	0	**12**	0	0	0	0	0	0	**0**	**12**	8
Cavia porcellus	Guinea pig	0	5	0	0	1	0	**6**	0	0	0	0	0	0	**0**	**6**	2
Meriones unguiculatus	Mongolian gerbil	0	0	0	0	0	0	**0**	3	0	0	0	0	0	**3**	**3**	2
*Mus musculus**	House mouse	3	5	2	0	3	3	**16**	5	4	0	4	3	0	**16**	**32**	23
Mustela putorius furo	Domesticated ferret	0	5	0	0	4	0	**9**	0	5	0	0	0	0	**5**	**14**	9
*Oryctolagus cuniculus**	European rabbit	4	5	5	0	0	4	**18**	5	4	4	3	3	3	**22**	**40**	23
Petaurus breviceps	Sugar glider	0	5	5	0	2	0	**12**	0	0	0	0	0	0	**0**	**12**	7
*Rattus norvegicus**	Norwegian rat	3	5	3	0	0	4	**15**	4	4	0	5	4	3	**20**	**35**	20
*Sciurus carolinensis**	Eastern grey squirrel	5	3	3	3	0	0	**14**	4	0	5	3	0	0	**12**	**26**	10
Overall scores		15	38	28	3	20	11	**115**	21	17	9	15	13	6	**81**	**196**	106

(Table 1). For each impact mechanism, different species had maximum scores, i.e., plants and vegetation (herbivory) (eastern grey squirrel), animals (predation) (Guinea pig, house mouse, domesticated ferret, the European rabbit, sugar glider and Norwegian rat), competition (common marmoset, black tufted-ear marmoset, European rabbit and sugar glider) and hybridisation (common marmoset and black tufted-ear marmoset) (Table 1).

Socio-economic impacts mechanisms

All assessed non-native small mammal species (n = 10) had socio-economic impacts except for the black tufted-ear marmoset, the Guinea pig and the sugar glider (Table 1). No significant differences between the impact mechanisms were found (Kruskal-Wallis test, $X^2 = 2.89$, df = 5, P = 0.54, Table 1). However, the most often mentioned impact mechanism was on agricultural production with a summed score of 21 (Table 1). Different species had maximum scores for each impact mechanism, namely, agricultural produc-

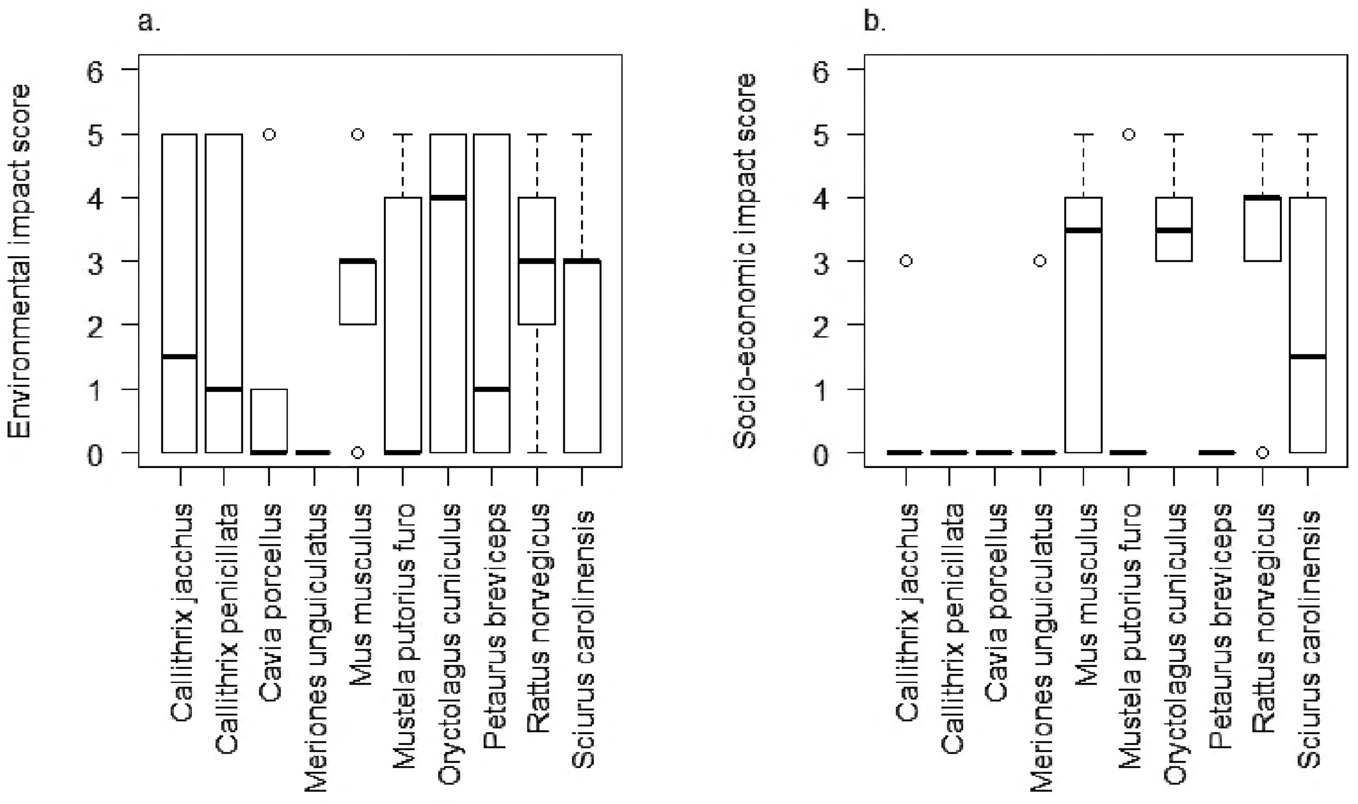

Figure 1. Box-plot showing **a** environmental and **b** socio-economic impact scores for the10 non-native small mammals available in the South African pet trade. (Boxes shows the 25th and 75th percentiles and whiskers (values below and above 5 and 4.5 for environmental and socio-economic respectively were considered as outliers) indicate maximum range, interquartile range, median, and the minimum range).

tion (house mouse and European rabbit), animal production (livestock) (domesticated ferret), forest production (eastern grey squirrel) and human infrastructure (Norwegian rat) (Table 1). Four out of 10 species had impacts on human health, and the Norwegian rat had the highest impact (Table 1). Only the European rabbit and the Norwegian rat had an impact on human social life, and these species had similar impact scores (Table 1).

Discussion

The non-native small mammals traded as pets and assessed in the present study had no significant differences between the overall environmental and socio-economic impact categories. However, a related study on feral mammal species by Hagen and Kumschick (2018) found a difference between environmental and socio-economic impacts where environmental impacts were significantly higher when compared with socio-economic impacts. An explanation for this difference could be that different domesticated non-native species were scored, and only three species were identical between the studies (Hagen and Kumschick 2018). Three species, the European rabbit, Norwegian rat, and house mouse were estimated to have the highest overall impact. Previous studies have also shown that these species have relatively high impacts in both environmental and socio-economic impact categories (Nentwig et al. 2010; Hagen and Kumschick 2018).

The environmental impacts of these three species with high scores were related to their impacts on other animals (predation) and competition, because they have caused the extinction of native species or generally compete with several species of high conservation concern. For example, the extinction of the Laysan crake *Porzana palmeri* in Hawaii has been linked to the introduction of Guinea pigs and European rabbits, and in Australia, rabbits outcompete the vulnerable rufous hare-wallaby *Lagorchestes hirsutus* for food and space (Lees and Bell 2008; Hume 2017). The house mouse and the Norwegian rat are associated with the reduction of native species and are also responsible for the extinction of several bird, insect and reptile species on different islands (Atkinson 1985; Marris 2000; Cuthbert and Hilton 2004; Zeppelini et al. 2007; Jones et al. 2008; Dagleish et al. 2017). These three species represent the most popular species in the South African pet trade industry (Maligana et al. 2020; Suppl. material 1, Table S1). In addition, the European rabbit is regarded as invasive on South African offshore islands, while the Norwegian rat and the house mouse are invasive on the mainland and offshore islands (Picker and Griffiths 2017; Measey et al. 2020). Consequently, these species may likely have higher impacts than other species scored in this study, given their establishment status in South Africa. There is also a lack of studies on the actual environmental and socio-economic impacts of these small mammals recorded in South Africa (Hagen and Kumschick 2018). It is also possible that most of the impacts reported elsewhere for these non-native mammals have already taken place in South Africa but are not yet documented. The results for the present study were different when compared with a study on non-native invertebrate pets in South Africa which found that popular species had minimal impacts (Nelufule et al. 2020). This difference may be explained by the fact that invertebrates are generally not well studied when compared with mammal species (Nentwig et al. 2010; Kumschick et al. 2015; Hagen and Kumschick 2019; Nelufule et al. 2020). Some popular mammal species in the pet trade, such as the sugar glider, have previously been reported to have relatively high potential ecological risk (da Rosa et al. 2018). This species can survive in the wild and has been reported to cause negative impacts on biodiversity by preying on the critically endangered swift parrot *Lathamus discolor* in Tasmania, Australia (Campbell et al. 2018). If this species is released from captivity, it can cause similar impacts in South Africa, as it is also popular in the pet trade, especially in the online trade (Suppl. material 1, Table S1).

The common marmoset and the black tufted-ear marmoset were the only species scoring high impacts through hybridisation. These two species have been reported to threaten the vulnerable populations of buffy-tufted marmosets *C. aurita* and Wied's marmosets *C. kuhlii* in Brazil (Nogueira et al. 2011; Cezar et al. 2017; Moraes et al. 2019). The hybrids of these two primates have been reported in the wild, and they are also fertile (Ruiz-Miranda et al. 2006; Oliveira and Grelle 2012; Malukiewicz et al. 2014). It is evident that these primates are a threat to populations of other marmosets in their introduced ranges. However, it is unlikely that these species will threaten the populations of other primates in South Africa as there are no native marmoset species. However, this does not suggest that these species will not cause impacts through other mechanisms as there is evidence of impacts on other animals through predation (Alexandrino et al. 2012).

The only species which recorded maximum impact on forestry production and plants or vegetation (herbivory) in the present study was the eastern grey squirrel. This species scored a maximum potential impact because it has been reported to cause impacts to endangered plant species, and its impacts have also resulted in major economic losses. For example, Lawton et al. (2007) reported that economic damage caused by eastern grey squirrels to beech *Fagus sylvatica*, sycamore *Acer pseudoplatanus* and ash *Fraxinus excelsior* (listed as near threatened by IUCN, (Khela 2013)) woodlands in the UK was estimated to be ~£10 million (Williams et al. 2010; Merrick et al. 2016). This species has also been reported to damage *Populus* × *euroamericana* plantations (Signorile and Evans 2007). Given that this species thrives in the urban and commercial areas in South Africa, it is likely to cause impacts on forestry production, nut, fruit and vegetable crops, and also telecommunication cables (Measey et al. 2020).

Several non-native mammal species assessed in the present study are regarded as agricultural pests (Reid et al. 2007; Girling 2013). Therefore, the impact on agriculture was high when compared with other impact mechanisms. The species responsible for the maximum potential impact under this mechanism were the house mouse and the European rabbit. These species scored high because their impacts were mostly associated with major economic losses on agriculture, and also their eradication plans required the application of pesticides which are expensive and have negative impacts (Twigg et al. 2002; Williams et al. 2010; Haniza et al. 2015; Capizzi 2020; Mill et al. 2020). In developing countries, invasive rats and mice compete with humans for food (Stenseth et al. 2003), targeting various crops such as cereals, rice, palm oil, fruits, cocoa, and sugarcane, which results in a significant economic loss and affects food security (Tobin and Fall 2004; Varnham 2006). The United Nations reported that in 1982 rats and mice damaged ~42 million tons of food globally, worth ~US $30 billion worldwide (Almeida et al. 2013). Even though there is lack of information on the impacts associated with non-native invasive rats and mice in South Africa, these species are likely to be causing socio-economic impacts. Studies in South Africa indicated that pesticides are used to control rats and mice in different households in urban areas (Balme et al. 2010; Rother 2012; Roomaney et al. 2012). This may suggest that these rodents may be problematic, but little attention has been given to the economic losses associated with control measures and other socio-economic impacts in general.

Domesticated ferrets were responsible for the highest impact through the animal production (livestock) mechanism. In New Zealand, they have been reported to host the *Bovine tuberculosis* disease that has been transmitted to livestock and threatens production of beef, dairy and venison markets (Ragg et al. 1995; Byrom 2002; de Lisle et al. 2008). Domesticated ferrets might also pose the risk of transmitting *B. tuberculosis* in South Africa, given that they are kept as pets and have become invasive after accidental escapes in New Zealand (Byrom 2002). The Norwegian rat had the highest score for infrastructural impact. Their damage to infrastructure includes gnawing of electric cables, burrowing, and contaminating water and food through droppings and urine (Johnson 2008; Garba et al. 2014; Panti-May et al. 2017). Their gnawing on communication cable and wires has further resulted in fires; as a result, repellents/rodenticides

are generally used to control them (Shumake et al. 2000). The Norwegian rat also had a high potential impact on human health in the present study because they carry pathogens that are transmittable and fatal to humans such as *Bartonella*, *Echinococcosis* and *Seoul* virus (Firth et al. 2014; Abdel-Moein and Hamza 2016). This rat has also been reported to bite humans, causing wounds which require medical attention (Donoso et al. 2004; Garba et al. 2014; Panti-May et al. 2017). It is possible that non-native invasive rats may threaten the health of humans in South Africa, given their wide distribution in the urban landscapes and having been found to carry zoonotic agents such as helminths, toxoplasmosis and leptospirosis (Taylor et al. 2008; Julius et al. 2018).

Only the European rabbit and the Norwegian rat had an impact on human social life, and these species had the same impact scores. Rabbit burrows cause damage to gardens and golf courses (Brown 2012). Norwegian rats also make damaging burrows, for example, in cities, especially under concrete sidewalks and in backyards (Sullivan 2004; van Adrichem et al. 2013). In South Africa, the Norwegian rat would likely cause severe human social life impacts when compared with the European rabbit given that it is distributed in urban areas and rabbits are present on the offshore islands only (Bastos et al. 2011; Julius et al. 2018; Measey et al. 2020). However, impacts associated with the European rabbit may be severe on the offshore islands where the species is known to reduce vegetation (Sherley 2016). Should species with high impacts be released or escape from captivity and establish feral populations, impacts reported in the present study may occur and results in reduction of biodiversity and economic loss during eradication and the repairing of damages caused.

Conclusions and recommendations

The present study showed that several of the South African non-native small mammal pets that are traded and were assessed pose either potentially high environmental and/or socio-economic impacts as documented in other countries. But of great concern are the following species: the European rabbit, the house mouse, the Norwegian rat and the eastern grey squirrel which have been reported as established in South Africa and its offshore islands (Picker and Griffiths 2017; Measey et al. 2020). The establishment of the European rabbit and the eastern grey squirrel in South Africa is associated with escapees from captivity (Measey et al. 2020). It is likely that these species are causing similar impacts in South Africa but unreported. We recommend that established species with high impacts should be prioritised for eradication and management. The trade for those species with significantly higher environmental and socio-economic impacts should be stopped and monitored, prioritised in policy development and regulations implemented so that their potential impacts in South Africa may be prevented. Regulations on the trade of non-native species exist, but these regulations are not implemented in many countries, and furthermore in South Africa, there is an increased demand for non-native pets and ongoing illegal trade (van Wilgen et al. 2008; Martin et al. 2018; Siriwat and Nijman 2018). To prevent impacts by non-native pet species, countries may need to document alien species traded, and do impact or risk assessments to identify invasive species, which may require management.

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Supplementary material 1

Table S1

Authors: Ndivhuwo Shivambu, Tinyiko C. Shivambu, Colleen T. Downs

Data type: pet trade data

Link: https://doi.org/10.3897/neobiota.60.52871.suppl1

Supplementary material 2

Table S2

Authors: Ndivhuwo Shivambu, Tinyiko C. Shivambu, Colleen T. Downs

Data type: impact assessment detailed scores

Explanation note: Assessment of non-native mammalian species sold in the pet trade in South Africa.

Link: https://doi.org/10.3897/neobiota.60.52871.suppl2